**‘Are we losing our way?’ Navigational aids, socio-sensory way-finding and the spatial awareness of young adults**

***Abstract***

*Recent advances in the accessibility and reliability of mobile technologies, roaming services and associated data have led to an increased usage of modern navigational devices using Global Navigation Satellite Systems (GNSS). This paper reports on a study which explored concerns about over-reliance upon these navigational technologies, specifically amongst young people in the Global North. Based on an experiment in which participants were asked to navigate a series of different (unfamiliar) routes on foot, using different navigational technologies each time, we argue that routes navigated are more memorable, and the process of way-finding is more enjoyable, when navigational tools/methods enable sensory and social interactions. GNSS aids, though claimed by participants as their preferred navigational aid, were the least enabling in this regard. We conclude that, whilst concerns about young people’s way-finding abilities may be overstated, the importance of sensory and social interactions with(in) environments might usefully be borne in mind in the development of future GNSS aids and locative media.*

**Introduction**

Way-finding is inherently sensory. We navigate according to what we see, hear, smell and touch, and respond emotionally to those stimuli in ways that both indicate and contribute to how we feel about a place (Rodaway 2002). Indeed, “our first and foremost, most immediate and intimately *felt* geography is the body, the site of emotional experience and expression *par excellence*” (Davidson and Milligan 2004, 523). Yet whilst this embodied sense-making (based on sense-using) is fundamental to our ability to navigate, human activity is enabled by navigational technologies; tools that expedite the process of journeying, way-finding and exploring (Black 2003).

Recent technological advances have precipitated declining use of 'traditional' paper maps (Ford 2014) in favour of navigation tools reliant on GNSS. Concern has been raised about the detrimental effect increasing reliance on these systems may have on our spatial awareness (Willis et al. 2009), including our instinctual way-finding ability. Whilst navigation has always been, to an extent, instrumental in purpose, the self-orientating nature of GNSS coupled with functionality that offers the fastest or most direct routes has amplified its instrumentality. The risk is thus that, "One is physically present but is absorbed by a technologically mediated world of elsewhere" (Gergen 2002, 227), such that users become 'cloistered' from participating in the (non-digital) social world (Nitins and Collis 2013). In contrast, non-digital navigational methods oblige the way-finder to situate her-/himself in her/his environment, using visual and social observations to help 'make sense' of their position. Yet GNSS need not distance the user from their environment; it may simply change the way in which they interact with their surroundings, cultivating new experiences of place (Halegoua 2015).

We situate our enquiry in relation to contemporary debates around both opportunities and challenges presented by GNSS and locative media (e.g. Farrelly 2015), particularly in relation to the role of senses and socialities in generating embodied way-finding skills (Symonds et al. 2017). Taking concerns about the impact of GNSS on human way-finding ability as our starting point, we explore how GNSS shapes users' interaction with their surroundings.

We focus here on young British adults' everyday way-finding. Having grown up alongside the development of smartphones and Sat-Nav systems, the way-finding methods of this group may, over time, increase in prevalence as digital way-finding tools become both increasingly ubiquitous and culturally normalised (Dutton and Blank 2011). Often framed as 'digital natives' (Bennett et al. 2008), young adults may, in some ways, be adept at

navigating online space (Gardner and Davies 2013). Here, however, we explore the impact of GNSS equipped technologies on their ability to navigate *physical* space; an area which, we argue, is under-researched.

**Navigation, technologies and sense(s) of place**

At its simplest, navigation refers to the practice of following an appropriate route between points. The spatial knowledge underpinning navigational competence has been shown to be directly proportional to the level required by an individual's needs (Maguire et al. 2000), though regular exercise of navigational skills is argued to be necessary to retain spatial awareness (Maguire et al. 2003). Indeed, Tuan (1977, 75) notes that, whilst "human beings are not endowed with an instinctive sense of direction […] under training the ability to stay orientated can be acutely developed." Raubal and Egenhofer (1998) suggest that human way-finding is a cumulative experiential process, in which familiarity with one location (e.g. the location of a shop relative to a station in one town) becomes transposed onto new navigational tasks (e.g. locating the shop in an unfamiliar town). This process necessarily involves the sensory perception and cognitive processing of spatial information, its transformation or modification, and the (re)creation of spatial images, "even without reference to an original physical stimulus" (Gardner et al. 1996, 207). In other words, and by extension, the more frequent an individual's navigation of the physical world via environmental cues, the better their spatial knowledge and overall navigational competence are likely to be.

Studies of how spatial information is perceived have found that information about a place is acquired through a variety of stimuli, including textures and smells (Badger 2013). Whilst this has been widely recognised by researchers seeking to enable way-finding amongst

those with sensory limitations (e.g. the visually impaired; Jacobson 2004), there has been less recognition of the multi-sensory nature of everyday way-finding for those without such limitations. This is in spite of growing recognition within human geography of the centrality of embodied sense-based sense-making to everyday experiences (e.g. Crang 2003; Paterson 2009). Bartos (2013, 89), for instance, notes that "places become meaningful based on a complex set of embodied sensory emotions", and Quercia et al. (2015) suggest that olfactory cues significantly influence a positive or negative perception of a place, often unknowingly to the individual concerned.

Whilst sensory perceptions of and responses to environments are thus central to the genesis of navigational competence, so too are social interactions. These commonly take the form of giving or receiving directions, a process where the scope for variation in understandings of language, gesture and space require environmentally situated interpretative work (Allen 1997; Montello and Sas 2006). The promotion of 'social walking' as a public health tool (e.g. Green 2009) has also cast light on the benefits of way-finding with others for maintaining and enhancing a range of cognitive processes. Linking these bodies of work are studies illustrating how interactions with others whilst way-finding can enhance feelings of being part of a neighbourhood (Richard et al. 2008), with the friendliness of those interactions contributing to both a positive sense of place and mental state (Sharpley and Jepson 2011).

Recently the advent of GNSS-based navigational aids has contributed new forms of information to the way-finding toolkit. Rapid expansion of such technologies, particularly through smartphone functionality, has significantly increased exposure to – and thus familiarity with – such systems (Axon et al. 2012). Yet, some argue that as dependency on technology grows, traditional (and often basic) navigational skills are being lost (Montello

2009). Research into the impacts of digital navigation technologies has considered impacts of such technologies on concentration and memory, as well as how (un)familiarity with the technologies impact on these variables (Ishikawa et al 2008). Experimental psychology research has also shown that use of GNSS navigational aids can 'switch off' the part of the brain that would otherwise be used to way-find (Javadi et al. 2017), with users becoming more immersed in the virtual GNSS world than their physical environment (Konkol et al. 2017).

Yet there is evidence of modern technologies involving GNSS enhancing the experience of place. Geocaching, for instance, promotes engagement with local geography by encouraging way-finding with reference to physical-environmental clues (Ihamäki 2014). Robinson et al. (2012) explore how information transmitted via GNSS device could be transferred to users in ways that encourage exploration whilst providing reassurance that the device is recalculating routes where users have strayed from the original suggested. These examples suggest that there may be positive contributions new technologies can make to place-attentive way-finding, as well as helping to ameliorate some of the challenges associated with their (over)use, by 'forcing' interactions with the environment more typically associated with non-digitally-mediated way-finding.

Before introducing our empirical study, we briefly consider why youth – often viewed as 'over-users' of digital technologies (Roberts 2014) – constitute a valuable case study for this enquiry.

**Young Adults 'Finding Their Way'**

Despite widespread characterisation of young people[i] as 'digital natives', how this perceived digital competence is used to navigate physical spaces has received patchy attention.

Studies by Leyshon et al. (2013) and Speake (2015) suggest that digital navigational technologies provide young people with a sense of security when way-finding, but also constitute a distraction from noticing place features. More generally, a knowledge gap exists around how digital technologies mediate young people's way-finding, particularly in relation to their sensory engagements with place and forms of sociality that contribute to making it both navigable and meaningful. Most academic literature concerned with young adults and navigation employs the term 'way-finding' with reference to navigation of the life course, rather than the more literal way-finding demanded by an unfamiliar physical environment. However the increasing use of smartphones amongst youth has spurred interest in how mobile digital technologies enable distinct forms of mobility, agency and visibility (Collins et al. 2013). Such tools have also been used methodologically to revealing effect, through participatory mapping as a means of understanding the co-production of spaces, and collaborative digital mapping oriented specifically to emphasise youth agency in different spaces (Gordon et al. 2016). On this basis, the role of personal digital technologies in promoting and enabling young people's navigation, inhabitation and/or negotiation of spaces is a field suited to further investigation.

Ooms et al. (2016) note how the growing ubiquity of map-related technologies, particularly via smartphones, mean young adults need the skills to process and apply the cartographic information they see. The importance of 'location literacy' (cf. Cahill 2000) for young people's self-identities, sense of competence and agentic expression remains, however, underexplored. Research into use of space by youth largely pre-dates widespread access to GNSS technologies, and tends to combine 'manual' mapping with other qualitative techniques, such as interviews (e.g. Vanderstede 2011), as a means of understanding how young people access, use and attribute meanings to spaces. Axon et al. (2012), however,

explored undergraduate geographers' views of GNSS tools via a questionnaire, finding that the students viewed such devices not as a form of map but as a 'navigational tool' (see also Speake 2015). The students responded positively to the technological and navigational capacities of the devices, though some expressed concern that GNSS use may compromise their navigational abilities.

There is considerable scope to better understand how digital navigational technologies shape young people's way-finding abilities and spatial awareness. Below we outline an experiment designed in response to this potential before discussing some of its key findings.

**Experiment**

The study aimed to assess the relationship between navigational aid and place feature recognition as a proxy for spatial awareness. Data collection was organised as an experiment in which eighteen 19-24 year olds were asked to navigate, in groups, three unfamiliar routes on foot. Participants were unaware of the experiment's specific aims. [ii]

Participants were limited to those educated in Britain to ensure some comparability of map-reading experience.[iii] In previous studies (Axon et al. 2012; Ishikawa et al. 2008) a correlation between the level of familiarity with a navigational tool and interests and hobbies was seen; those with geographical interests being more familiar with paper maps (Hurst and Clough 2013). Most respondents to the call for participants to take part in a 'navigational experiment' were, perhaps unsurprisingly, Geography students. To ameliorate, to an extent, bias caused by many geographers in one group, those reading Geography were limited to one per group, with further recruitment via means of snowball sampling resulting in many academic fields represented.

Each group completed a navigational task in three towns named, for the purposes of this study, A, B and C. The routes used were selected on the basis of: i) ease of accessibility from the 'home' university; ii) likelihood that students would not have visited the locations before; and iii) suitability as determined by a group of pilot participants, separate from the main study cohort. Participants were also asked, as part of a preliminary questionnaire, their level of familiarity with the chosen towns. Those with some knowledge of the areas (aside from the general location of the town) were deemed unsuitable participants as they may have remembered features from previous visits. In each town participants were asked to travel on foot between a residential street and a transport interchange, between 0.5 - 0.9 miles from the starting point. There was no stipulation to find the fastest or most direct route to avoid placing undue attention on completion of the task rather than the way-finding process.

For each iteration of the task groups were provided with a different navigational tool (Table 1).

[INSERT TABLE 1 ABOUT HERE]

The two most commonly used navigational tools in the UK were utilised – an Ordnance Survey paper map and Google Maps GNSS application. To explore concerns about a loss of navigational skills, on one route participants were given no tool, referred to here as the 'blind' method. Each group was provided with a tracker, allowing the researcher to follow discreetly.[iv]

Whilst we note Paterson's (2009) reflections on the difficulties and limitations of trying to use words and images to communicate (multi)sensory experiences of space, interviews and sketches were a convenient and, for the participants, familiar means of exploring journey recollections. 24 hours after the way-finding task a one-to-one semi-structured interview was completed with participants in order to explore their experience of the way-finding task and their sense(s) of each place. Drawing on Vandeviver's (2014) use of hand drawn maps to explore spatial and place awareness, participants were also asked to sketch the route taken. Features such as people, sensory recollections and buildings were identified and their significance discussed, with the number and distribution of features noted.

Below we highlight some key findings from this experiment. We comment first on participants' engagement with their GNSS aids, before highlighting how the social and sensory experiences of way-finding both shaped and were shaped by each of the navigational tools.

**GNSS-led navigation: challenging limitations with resistance**

Across all sketch maps and interviews, there was considerable variation in place feature recollection. Whilst this may in part be due to natural variation in participants' 'spatial intelligence' (Gardner et al. 1996), results suggest an important role was played by navigational aid. Table 2 shows that participants recalled fewer place features from routes navigated with the GNSS tool.

[TABLE 2 ABOUT HERE]

This difference was also conspicuous in the sketch maps. Figure 1 compares participant 4's representations of the areas navigated.

[INSERT FIGURE 1 ABOUT HERE]

These results suggest less spatial knowledge was gained whilst using the GNSS-equipped device (using the feature counts as a proxy). Some participants' comments indicated they felt their spatial knowledge had been compromised: "I feel that having used a GPS[v] I have no knowledge of [GNSS route]" and "Because we used the GPS I didn't take much notice of what was around me". This provides some validation of claims of disengagement from surroundings whilst navigating with a GNSS device, as instructions are prioritised over environmental observations. In contrast, participants who used both the 'blind' and paper map methods demonstrated spatial knowledge beyond navigated routes, including their knowledge of a stadium away from routes chosen in Town A, and a village a kilometre away from Town C. This reading of the landscape and retention of the spatial information observed supports claims that paper maps and/or direct experience (akin to our 'blind' method) may contribute to the acquisition of more fulsome spatial awareness than GNSS-led way-finding (Ishikawa et al. 2008).

That some groups overruled their GNSS unit – "We got to a place where the GPS told us to go that way, but we decided to go the other way" – suggests, however, that concerns regarding subservience to GNSS may be overstated. Indeed, choosing to ignore GNSS units could be argued to demonstrate participants' already-embodied navigational competence,

past experience building confidence in transposing spatial knowledge onto a new setting. Dismissal of GNSS may also have reflected place curiosity amongst some groups – an opportunity to explore, albeit with the 'safety net' of technology if required (Leyshon et al. 2013). One participant stated that they "just like to wander around anyway", and another that they "wanted a bit of an explore." There are echoes here of Baudelaire's (1863 [1995]) *flâneurie* - strolling with an intentional focus on 'taking in' the surroundings. This in turn implies a sense of constraint imposed by GNSS-led way-finding that these individuals sought to resist, and that participants gained something from way-finding beyond reaching a destination.

**Social way-finding**

The under-acknowledged socialities of way-finding (Brown and Laurier 2005; Montello and Sas 2006) were highlighted by participants' interactions with the public as they sought to capitalise on locally embodied place knowledge. More engagement with people along the route was evidenced whilst using the 'blind' method: "We actually spoke and met somebody in [Town A]", and "in [Town C] we spoke to a group of about five kids". Participants described these interactions as a method of gaining reassurance about their route choice - "We confirmed if this was the way to the train station, as not in all centres is it actually there" – underlining how embodied knowledge of the (il)logics of different places' spatial arrangements (e.g. that train stations are not always in a town centre) helps wayfinding in new environments (Raubal and Eigenhofer 1998). Another participant recalled features along their group's route from a local's directions that referred to locations as waypoints (e.g. "past the […] fish shop"). These interactions both helped to validate knowledge-in- and knowledge-of-place as well as helping to make places memorable

through language and gestures used to describe and distinguish between them (Cresswell 2014). This produces shared, negotiated understandings of place, in turn building understandings – even intimacies – between the people who journey through it (Laurier and Lorimer 2012). As such there may be hitherto un(der)acknowledged social benefits to way-finding that demands interaction with others, beyond the benefits for individual navigational competence.

In some instances navigational decisions and social interactions overlapped: "[Participant 13, 'blind' route] got confused as she thought we might have to go down a different road but as we got closer we decided no." Here, social interactions combined with environmental observations to enable negotiated way-finding. Another participant, recounting their GNSS route, noted, "well, we had the GPS (…) but then when we saw two people we felt we should go and ask them to make sure." These 'hybrid' navigational approaches reassured participants in their reading of place, underlining the potential value of GNSS-equipped navigational tools that encourage what might be termed 'reassured exploration' (Robinson et al. 2012).

**Sensory way-finding**

In addition to the social demands of navigation, participants were also faced with the interpretative work of using sensory information to inform their journeys. The decision by some groups to take 'off-road' routes when navigating with the paper map exposed them to stimuli that made those routes particularly memorable. For example, participants reported awareness of natural phenomena whilst using the paper map to navigate Town C, saying, "[There were] six or eight birds in a field" and "Loads of hedgerow, hedgerow was here."

Others described smelling chips and hearing cows mooing, demonstrating the potency of multi-sensory place experiences for the development of place knowledge (Quercia et al. 2015). This contrasts with another participant's description of the same route using GNSS, in which only reference to the built environment is made: "The alleyway to the train station and quite a few bars." Participant 6's sketch maps (Figure 2) also evidence this pattern, with the inclusion of more natural[vi] features, such as a "steep muddy path" and "wild birds" on the paper map route compared to the 'blind' and GNSS routes.

[INSERT FIGURE TWO ABOUT HERE]

Participant 6 may have recorded a large number of 'natural' features simply because the route taken passed more of them. Yet data from other participants, on different routes, also indicated scant evidence of interaction with anything other than the built environment when using GNSS. This pattern, reflected throughout the sample, also highlights the importance for place information recall of place temporalities (Wunderlich 2010), such as the 'wild birds' featured in Figure 2, which may only be present at certain times of day. Such time-specific characteristics appeared to contribute to a positive opinion of the location.

**Navigational preferences**

Despite professed enjoyment of the routes navigated with paper maps - "My favourite route, probably the one with the [paper] map [Town A].", "I'd say of all of them, [Town B, paper map] was my favourite" - as a method the paper map was viewed overwhelmingly negatively: as "not practical", "out of date" and "hassle". In contrast, GNSS was the preferred method for most: "The GPS did it for us so was dead good." However, GNSS

navigated routes were described overwhelmingly negatively, irrespective of the location: "[GNSS route] was a bit cold, and boring, it just felt like a straight road we turned a bit on"; "That one [GNSS Route] was my least [favourite]".

This inverse relationship may, at least in part, be explained by the level of autonomy exercised on each route, i.e. the extent to which navigators used their interpretative skills, based on sensory and social cues. There seemed a sense of satisfaction and confidence that came from engaging in interpretative work – some groups actively sought this out by ignoring their GNSS. How, then, do we make sense of their stated preference for GNSS as a navigational aid (cf. Speake 2015), when participants were more attuned to sensory experiences, interactions with people and nature, and the enjoyment of way-finding when navigating *without* it? We reflect on this quandary in our conclusion.

**Conclusion**

This experiment has sought to prompt further debate around, and research into, technologically-mediated way-finding and its impact on spatial awareness and sense of place, particularly – but not exclusively – amongst younger navigators. Here, young adults' preference for digital navigational aids was made clear; but so too was their more positive experience of way-finding when navigating without them. Further, their capacity to recall place characteristics was stronger when GNSS was not used. This suggests that the sensory, social and emotional experiences of journeying-through are important in producing the embodied place-knowledge which enables future navigation.

How then to make sense of participants' professed preference for GNSS? Perhaps it was due to a dual feeling of safety: safety from getting lost, but also the safety of familiar

functionality. Claims for smartphone GNSS utility in relation to way-finding may also be a means of validating emotional attachment to these devices. Yet this familiarity and attachment risks inhibiting forms of way-finding that are – by participants' admission – enjoyable, exciting, and practically useful. As Morozov (2013, cited by Farrelly 2015) notes, the increasing dictation of spatial experience by computer logic may reduce the unpredictability and happenstance that contributes to the meaningful experience of space.

We want to be clear that we do not suggest that digital aids are inherently detrimental to way-finding or to the experience of place. Rather, we seek to encourage more critical consideration of how digital technologies might be used to encourage sensory, social and emotional engagement with place as part of way-finding. Robinson et al. (2012) highlight considerable potential for GNSS-based information to be communicated to users in ways which enhance innate human navigational instincts and socio-sensory needs (see also Konkol et al. 2017). Activities such as geocaching, alongside the exploratory and social walking encouraged by apps such as *Go Jauntly* (Franks 2018), seem to fulfil this brief. In this way, "…technological innovations aimed at providing verbal information to assist way-finding activity [can] be incorporated within a framework focused on the ecology of way-finding behavior" (Allen 1997, 363). Future digital navigational aids, rather than showing fastest routes, may instead show the quietest or most sociable. Yet an important question the emergence of such technologies poses regards the extent to which mediation by technology negates the benefits of purely sensory-social-emotional way-finding. With this experiment we hope to have signposted several new avenues for future exploration in this field.

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[i] The distinction between childhood and youth is widely acknowledged to be blurred, as well as spatially varied and culturally specific (see, amongst many others, Skelton and Valentine 1998; Evans 2008), with no agreed definition of when one life stage ends and the other begins. Whilst a more substantive consideration of the navigational experiences of children vis-à-vis youth is beyond the scope of this paper, we acknowledge that differences in understanding of relational place will exist according to (amongst other factors) the age of the navigator(s) concerned. On that basis, we limit our consideration of relevant literature in this paper to that explicitly concerned with *youth/young adults*. We also note that the development of literature on *children* and GNSS technologies, whilst still in its infancy (see Jarvis et al. 2017), appears more developed than that focused on youth/young adults.

[ii] The call for participants was worded such that participants were unaware of the specific aims of the experiment, in order to avoid participants note- or photo-taking en-route to aid memory. The term 'navigational experiment' was used to describe the study until after the interview and sketch-map exercises.

[iii] Map-reading skills were introduced to the English and Welsh National Curriculum in 2001.

[iv] Ironically in the form of a GNSS equipped device via the application *'Find my Friends'*.

[v] The term 'GPS' is used in direct quotations of participants, as this is the term that they were familiar with.

[vi] For the purpose of this article the term 'natural' refers to features other than the built environment.